PROXIMATE COMPOSITION AND FATTY ACID PROFILES OF MUTTON AS AFFECTED BY SEASON, PLACE OF PURCHASE AND CUT

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Abstract – The objective of this study was to establish the intramuscular fat, moisture content, fat free dry matter and fatty acid profiles of mutton cuts purchased from rural and urban localities in different seasons in the Eastern Cape Province, South Africa. Meat portions sampled included loin, sirloin, ribs, were taken from a total of 80 mutton samples were purchased from 40 different shops and butcheries in rural and urban areas in each of the four seasons. Samples were immediately transported to the laboratory in cooler boxes with ice and stored at -20°C pending fatty acid analysis. Loin and sirloin cuts recorded the highest intramuscular fat whilst rib and leg cuts recorded the lowest intramuscular fat. Mutton purchased in the winter had the lowest moisture content, highest intramuscular fat and fat free dry matter whilst mutton purchased in spring and summer recorded the highest moisture content and lowest intramuscular fat. Rib and cutlets had the highest linoleic acid (5.2±0.68 and 5.1±0.27 respectively), linolenic (1.9±0.09 and 1.9±0.23), arachidonic (1.6±0.09 and 1.4±0.23) and DPA (0.6±0.03 and 0.05±0.08).

Key Words – Linoleic acid, Loin, Winter

- INTRODUCTION

People have been eating mutton throughout the history of mankind, as it is a dense source of nutrients which are vital for growth and development [1]. In South Africa, recent statistics show a decrease in mutton consumption due to health related worries [2]. The health conscious consumers consider the fat and saturated fatty acid composition in mutton to be too high [3]. Evidence has shown an association between saturated fatty acids and occurrence of cardiovascular diseases [4]. This has seen recent studies focusing on understanding the fatty acid profiles and improving individual fatty acids that convey good health to the consumer through various methods [5].

Approaches used in improving fatty acid profiles include; nutritional strategies [6], age grouping and portion selection [7] and breed selection [8]. However, the composition of fatty acids is also affected by season and region/ place in which mutton is purchased [9]. A few studies have described nutritional composition, including fatty acids profiles, of mutton sold to the public in rural and urban set-ups. Furthermore, most studies aim at analysing only the M. *longissimus dorsi* tissue yet there are so many retail cuts available in South Africa.

The aim of the study was to determine intramuscular fat, moisture content, fat free dry matter and fatty acid profiles of mutton cuts purchased from rural and urban localities in different seasons in the Eastern Cape Province.

- MATERIALS AND METHODS

Study site and data collection

The study was conducted in five different municipalities situated in the Eastern Cape province of South Africa. Selected areas were categorized into urban (East London, King Williams Town, Queenstown, Stutterheim, Cathcart, Adelaide, and Fort Beaufort) and rural towns (Alice, Middledrift and Peddie). Eighty mutton samples were collected from 40 different shops and butcheries from the chosen municipalities in each of the four seasons i.e., summer, autumn, winter and spring. The following mutton portions were randomly sampled; chump, leg chop, loin chop, rib chop, shoulder chop, brisket chop, trotters. These samples were immediately delivered at ≤ 4°C to the laboratory in a cooler box containing ice.

Meat sample analysis

Intramuscular fat, moisture content and fat free dry matter were measured and other replicate samples were then stored at -20°C pending further analysis. Total lipid fraction was extracted according to (10) procedures for determination of fatty acids. Total lipids from muscle samples were quantitatively extracted, according to the method of (11), using chloroform and methanol in a ratio of 2:1. Total extractable intramuscular fats were determined gravimetrically from the extracted fat and expressed as percent fat (w/w) per 100g tissue. Fatty acid methyl esters (FAMEs) were prepared for gas chromatography by methylation of the extracted fat, using methanol–BF 3 (12) and quantified using a Varian GX3400 flame ionization GC, with a fused silica capillary column, Chrompack CPSIL88 (100m length, 0.25 mmID,0.2 mm film thickness). Fatty acid methyl ester samples were identified by comparing the retention times of FAME peaks from samples with those of standards obtained from Supelco (Supelco37Component Fame Mix 47885-U, Sigma-Aldrich Aston Manor, Pretoria, South Africa). Fatty acids were expressed as the proportion of each individual fatty acid to the total of all fatty acids presenting the sample.

Statistical analysis

General Linear Model (GLM) procedure of SAS (2003) was used to analyse the effect of place of purchase, season and mutton portion on intramuscular fat, fat free dry matter, moisture content and fatty acid profiles. The following model was used; $Y_{ijkl} = \mu + \alpha_i + \beta_j + \Omega_k + e_{ijkl}$

- RESULTS AND DISCUSSION

Intramuscular fat, moisture content and fat free dry matter composition

The results on the effect of season, place of purchase and mutton cut are shown in Table 1. In the current study, rural and urban purchase points did not significantly influence moisture content, intramuscular fat and fat free dry matter of mutton. However, significant differences observed in the moisture content, intramuscular fat and fat free dry matter of mutton purchased in different seasons.

Information on the proximate composition of raw mutton is important in evaluation of production and also nutrients retained by consumers [7].

Table 1 Effect of season, place of purchase and meat portion on intramuscular fat, moisture content and fat free dry matter of mutton

	Moisture content	**Intramuscular fat**	**Fat free dry matter**
Season			
Spring	$73.9^{b}\pm0.25$	$4.0^{a}\pm0.21$	$21.5^{a}\pm0.18$
Summer	$73.9^{b}\pm0.25$	$4.4^{a}b\pm0.21$	$21.7^{a}\pm0.18$
Autumn	$73.5^{b}\pm0.19$	$4.5^{b}\pm0.16$	$22.0^{ab}\pm0.14$
Winter	$72.6^{a}\pm0.26$	$5.3^{c}\pm0.21$	$22.3^{b}\pm0.18$

P-value	0.01	0.001	0.01
Place of purchase			
Rural	73.5±0.19	4.5±0.16	21.8±0.18
Urban	73.4±0.16	4.5±0.13	21.9±0.10
P-value	Ns	Ns	NS
Meat portion			
Brisket	$74.6^{b}\pm0.44$	$3.7^{bc}\pm0.35$	21.6±0.30
Chump	$74.1^{b}\pm0.29$	$4.1^{cd}\pm0.23$	21.7±0.19
Cutlets	$74.1^{b}\pm0.29$	$3.2^{ab}\pm0.52$	22.7±0.44
Leg	$74.5^{b}\pm0.22$	$3.6^{b}\pm0.18$	21.8±0.15
Loin	$71.3^{a}\pm0.30$	$6.1^{e}\pm0.24$	21.4±0.20
Rib	$74.9^{b}\pm0.25$	$2.9^{a}\pm0.20$	22.1±0.17
Shoulder	$73.9^{b}\pm0.21$	$4.2^{cd}\pm0.17$	21.9±0.39
Sirloin	$69.7^{a}\pm0.57$	$8.6^{f}\pm0.46$	21.9±0.39
Trotter	$74.1^{b}\pm0.56$	$4.5^{d}\pm0.45$	21.7±0.38
P-value	0.001	0.001	NS

Least square means in same column for each description (season, place of purchase and meat portion) with different superscripts differ significantly)

Mutton purchased in the winter had the lowest moisture content, highest intramuscular fat and fat free dry matter whilst mutton purchased in spring and summer recorded the highest moisture content and lowest intramuscular fat. The inverse relationship between moisture and fat content was also observed by Cloete et al. [8]. Intramuscular fat content of raw meat influences sensory properties such as initial juiciness, sustained juiciness and first bite [9]. Mutton of high intramuscular fat has high juiciness and is preferred by most consumers.
Mutton cuts were different in proximate composition. Loin and sirloin cuts recorded the highest intramuscular fat whilst rib and leg cuts recorded the lowest intramuscular fat. Similar observations were made by Sainsbury et al. [14].

Effect of season on mutton fatty acid profiles

Place of purchase did not significantly influence fatty acid profiles. However, fatty acid profiles differed according to season and type of cut. The effect of season is summarized in Table 2.

Oleic acid (38.4%), palmitic acid (28.7%) and stearic acid (16.3%) predominated. Saturated fatty acids, including were highest in spring but lowest in winter. The levels of vaccenic acid, linoleic acid, linolenic acid, arachidonic acid, DPA, DHA and lignoceric acid were lowest in winter and highest in spring. Monounsaturated and polyunsaturated fatty acids were also lowest in winter and highest in spring. This also corresponded with highest *n*-3 and *n*-6 fatty acids in winter and lowest composition in spring. Omega-3 and *n*-6 fatty acid are essential to human health [15]. Fatty acid composition in winter can impart a positive influence to health as saturated fatty acids are lower. These results were also reflected in the *n*-6/*n*-3 ratio were the ratio was significantly lower in winter and highest in spring. The lowest ratio tends to support better cardiovascular health compared to a higher level[16].

Results of *n*-6/*n*-3 from this study were within a range (1.53-7.65) noted by [17] even for grass-fed and grain-fed animals.

Effect of cut/portion on mutton fatty acid profiles
Vaccenic, CLA, eicosatrienoic, heneicosanoic acids were not significantly different in meat portions. However, linoleic, linolenic, oleic, arachidonic, DPA, DHA were significantly affected by portion type. Rib and cutlets had the highest linoleic acid (5.2±0.68 and 5.1±0.27 respectively), linolenic (1.9±0.09 and 1.9±0.23), arachidonic (1.6±0.09 and 1.4±0.23) and DPA (0.6±0.03 and 0.05±0.08). Generally, loin and sirloin cuts had the lowest DPA, linoleic acids giving an advantage to health as these fatty acids have a cholesterol reducing effect (15, 16).

Table 2 effects of season on fatty acid profiles

	Spring	Summer	Autumn	Winter
VA	1.3^{b}±0.04	1.2^{ab}±0.04	1.2^{ab}±0.03	1.1^{a}±0.04
LIN	5.0^{d}±0.27	4.1^{b}±0.27	4.8^{c}±0.21	3.3^{a}±0.28
CLA	0.5±0.03	0.5±0.03	0.5±0.02	0.5±0.03
α-LA	1.6^{b}±0.09	1.5^{b}±0.09	1.6^{b}±0.07	1.2^{a}±0.09
ARA	1.3^{b}±0.09	0.9^{ab}±0.09	1.2^{b}±0.07	0.7^{a}±0.09
EPA	0.1±0.01	0.1±0.01	0.1±0.01	0.1±0.01
HEN	0.1±0.03	0.1±0.01	0.1±0.01	0.1±0.01
OLE	38.6^{ab}±0.51	39.4^{b}±0.52	37.7^{a}±0.39	38.3^{ab}± 0.52
DPA	0.5^{b}±0.03	0.3^{a}±0.03	0.4^{ab}±0.03	0.3^{a}±0.03
DHA	0.2^{b}±0.02	0.2^{b}±0.02	0.2^{b}±0.01	0.1^{a}±0.02
LIG	0.5^{c}±0.04	0.3^{a}±0.04	0.4^{b}±0.03	0.3^{a}±0.04
SFA	48.8^{a}±0.49	49.6^{a}±0.49	50.1^{a}±0.37	52.6^{b}±0.5
MUF	42.2^{b}±0.5	42.9^{b}±0.5	41.2^{a}±0.41	41.4^{a}±0.6
PUF	8.9^{c}±0.43	7.4^{b}±0.43	8.7^{c}±0.33	6.1^{a}±0.43
*n*6	6.7^{c}±0.35	5.6^{b}±0.35	6.5^{c}±0.27	4.5^{a}±0.36
*n*3	0.2^{b}±0.01	0.2^{b}±0.01	0.2^{b}±0.01	0.1^{a}±0.01
PS	0.2^{b}±0.01	0.2^{b}±0.01	0.2^{b}±0.01	0.1^{a}±0.01
*n*6:*n*3	3.7^{b}±0.32	3.6^{ab}±0.33	3.6^{ab}±0.25	3.5^{a}±0.33

Least square means (± s.e) in the same row with different superscripts differ (P<0.05)

- CONCLUSION

Promotion of health is complex issues as there is need to balance many nutrients especially fatty acids. However, the current study provides a reveals another opportunity for consumers. Rib and cutlets are consistent with health promotion as *n*-3/*n*-6 ratios are lower than any other mutton portions. Selection of these cuts in winter may influence better cardiovascular health.

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